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THE ELECTRIFICATION OF OUR RAILWAYS.

Electric Traction: A Treatise on the Application of Electric Power to Tramways and Railways. By A. T. Dover. Pp. xix + 667 + 5 folding plates. (London: Whittaker and Co., 1917.) Price 18*s*. net.

IN electric traction the questions that have to be discussed may be broadly classified under two headings—technical and financial. The author touches on the latter class incidentally, and then only because it is impossible to leave financial considerations out of account altogether. In the former class he has not included descriptions of generating stations and transmission lines. Even with these restrictions, however, it is only by the severest compression that he has managed in a single volume to give the necessary descriptions of the line, the rolling stock, the appliances and apparatus used in electric traction, and to touch on most of the technical and theoretical considerations involved. We congratulate the author on having succeeded in writing a treatise which engineers and advanced students will find most useful. He is evidently well read in the literature of the subject, most of which is published in the Proceedings of various engineering societies and technical journals, both in this country and abroad, and is therefore inaccessible to many.

In Britain railway electrification is mainly confined to large cities and their immediate neighbourhood. In most cases this traffic has been stimulated by the necessity of competing with tramcars and motor-omnibuses. Unless the railway companies are content to give up a large fraction of the suburban traffic, they must adopt the expedient of electrifying their lines. This expedient, although costly, has proved successful, and many people wonder why the English railways do not at once set about electrifying their main lines. They say that electrification is bound to come, and point out that morally it is wicked to go on burning coal extravagantly in locomotives, seeing that our coal resources will certainly not last for ever. It will be well, therefore, to point out some of the reasons which are making engineers hesitate.

On suburban lines the stations are close together and the trains are continually starting and stopping. Under these conditions an electric train, owing to its higher schedule speed, can carry a larger number of passengers in a given time than a steam train having equal seating accommodation. The number of signal and train movements required for an electric train entering and leaving a terminus is only one-quarter of the number required for a steam train, and for this reason a much larger traffic can be handled by the electric trains before the traffic in the station gets congested.

For main-line railways the problem is more difficult. The efficiency of a modern steam locomotive is very high, and when it has to haul a fast passenger train over a long distance on a level track it is working at its very highest efficiency. The cost of the electric locomotive that could replace it is very heavy, and when we take into account the interest on the great initial expense of electrifying the line, the saving effected, if any, is very small. If, however, there are heavy gradients on the line or long tunnels, electric traction may prove much the more economical. On a steep gradient the potential energy of an electric train can be converted into electrical energy and pumped back into the line. On the Giovi-Genoa line of the Italian State Railways, for instance, the energy recuperated on the down grade is from 60 to 80 per cent. of the energy consumption by the same train on the up journey. The results of tests on a train equipped with motors connected for "regenerative control" on the Metropolitan Railway in Paris show a saving of 20 per cent. of the energy consumption. In addition, the adoption of regenerative control effects appreciable economies in the maintenance costs of the brake shoes, wheel tyres, and rails. The saving in the rails is an especially important item.

Unfortunately, there are several different electrical systems for railways, of which the most important are the direct-current, the three-phase alternating-current, and the single-phase alternating-current systems. There are numerous able advocates of each of these systems, and they can instance in support of their contentions commercially successful electric railways. It is of vital importance to the future of a railway that it should choose the right system of electrification at the start, for the advantages of interchange of traffic between railways are obvious. In the interests of the country there is a pressing need for standardising an electric traction system as soon as possible, and so we hope that the usual costly period of waiting for the survival of the fittest will be brief. For this reason we welcome books of this type, which will enable railway engineers to appreciate the relative advantages and disadvantages of the various systems and so help them to come to a decision.

The author starts with a short and accurate introduction to the mechanics of train movement. It is an excellent example of one of the practical uses of the theory of dynamics taught in all our schools. We next come to chapters discussing in an instructive way various kinds of direct- and alternating-current motors. The modern methods of testing and controlling them are given. Halfway through the book we come to chapters describing the rolling stock for tramways and railways, electric locomotives, and track and overhead construction for tramways and railways. The last two chapters are on feeding and distributing systems and on substation converting machinery respectively. In addition, numerous examination questions are set, the answers being

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given to the numerical ones, and references to the text in the case of the descriptive ones. We have satisfactorily checked some of the calculations, and the book is laudably free from misprints. There is little original matter in the work, but the author shows good judgment and no little knowledge in his selection and treatment of the various branches of this important subject.

We are sorry that the author was compelled by considerations of space to devote little more than half a page to the important subject of lightning arresters. He divides them (p. 279) into (1) the aluminium cell arrester, (2) the spark-gap arrester, and (3) the non-arcing arrester. We usually divide them into (1) the electrolytic, (2) the intermittent, and (3) the continuous types of arrester. Engineers are probably familiar with the devices mentioned, but the non-technical reader will have to look up the references given at the bottom of the page. The numerous references form a useful feature of the book.

A. RUSSELL.

COTTON CULTIVATION IN THE UNITED STATES.

Field Crops for the Cotton-Belt. By Prof. J. O. Morgan. Pp. xxvi+456. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 7*s.* 6*d.* net.

THE "Rural Text-book Series" has furnished the agricultural students of the United States of America with several very useful volumes. Prof. Oscar Morgan's contribution now before us worthily upholds the reputation of the series, and is likely to be accepted as having a value considerably beyond the sphere of usefulness very possibly contemplated for it by its author.

Coming from an expert resident in Texas (the most important of the cotton-producing States), the book will be appreciated by cotton-growers throughout the world. In that light it is perhaps unfortunate that so much elementary science was thought necessary. The first principles of the physiology and chemistry of plant life might have been left to the lower school text-book. A glossary of terms would have got over any difficulty presumed to exist and might, at the same time, have been made useful to the general reader not familiar with American agricultural terms and expressions. For example, it is somewhat amusing to find the expression "Irish potato"; tobacco a stimulant; buckwheat a cereal; the "cotton square"; the "Corn-Belt"; the silking of corn, etc.

Setting these minor considerations on one side, there are numerous features of the work of great merit. It is a considered and practical exemplification of the actual conditions and experience of cotton production of the States, framed primarily for use in schools and colleges.

Limitations of space will not permit of a detailed analysis, but it may suffice if we indicate one comparative aspect, namely, between the States and India, as illustrative of the numerous practical bearings of the book. Prof. Morgan describes very fully ten of the associated crops in the Cotton-Belt. The first and most important is corn, or, as in Europe it is more generally called, Indian-corn (*Zea Mays*). This, it would seem, occupies 38 per cent. of the belt, while cotton takes 39 per cent.; then follow (but far behind in point of area) oats, 3·7; wheat, 3·5; kafir and milo, 1·4; pea-nut, 0·9; rice, 0·8; sugar-cane, 0·6; while sweet sorghum, rye and barley show still smaller percentages. Practically all the cotton, sugar-cane, rice and pea-nuts grown in the United States come from the Cotton-Belt.

It may now be useful to exhibit a parallel assortment of the crops associated with cotton in India. Indian-corn, sugar-cane, rice, pea-nuts are not recognised as important crops in, and the Indian supplies of these are not drawn from, the cotton-producing districts. Oats and rye (except on the hills) can scarcely be said to be grown in India. Barley and wheat only occasionally accompany cotton, the former, as a rule, being mainly produced outside the cotton districts. On the other hand, Sorghum (*juar*), Pennisetum (*bajra*), Cajanus (pigeon-pea), Sessamum (*til* seed), Linum (linseed), and *Hibiscus cannabinus* (Deccan hemp) are very closely associated with the Indian cotton.

The Indian crops associated with cotton might be described as a slightly more tropical set than the American, and they denote at the same time differences in soil, climate, seasons of growth, tillage, manuring, and stock—differences that collectively account very possibly for the lower grade of the staple in India as compared with that of the United States. And perhaps the most vital aspect of these differences is the fact that the Indian cotton associates can scarcely be spoken of as rotated with it.

The Indian rotation, such as it is, is usually within the year, not after the lapse of one or more years. That is to say, two crops are taken off the same field every twelve months, one being cotton and the other the alternate crop. Interplanting is also largely followed, more especially with pigeon-pea (Cajanus), or with *juar* (sorghum, but only rarely the sweet sorghum), the balance in the soil being thereby to some extent preserved. Thus, while in India cotton is often grown year after year on the same field, our author tells us that in the States a three- or four-year rotation is universally accepted as essential. Thus: 1, cotton; 2, corn; 3, oats and wheat; and 4, cow-peas.

A study of the book leaves the conviction of its practical utility so deeply impressed that one is constrained to recommend improvement of existing supplies (especially Indian) on the lines set forth by our author as a more rational procedure than the discovery of new areas of production.

The book may be commended to all persons interested in cotton or the associated crops of cotton.

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